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Completion of One-Year Bioventing Test...

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE TEXAS

27 Jun 94

MEMORANDUM FOR 437 SUPPORT GROUP/CEV
ATTN: MR. MARK SMITH

FROM: HQ AFCEE/ERT
8001 Arnold Drive
Brooks AFB TX 78235-5357

SUBJECT: Completion of One-Year Bioventing Test, Fire Training Area, FT-03

The Air Force Center for Environmental Excellence (AFCEE) one-year bioventing test and evaluation project at the Fire Training Area, FT-03 has been completed. Figure 1 provides general site information and Table 1 provides a summary of initial, six-month, and one-year fuel biodegradation rates measured at several monitoring points. Biodegradation rates have varied slightly during the one-year pilot test. Some of these changes can be explained by soil temperature variations. Table 2 provides a summary of initial and final soil and soil gas sampling results for total recoverable petroleum hydrocarbons (TRPH) and benzene, toluene, ethylbenzene, and zylenes (BTEX). Figure 2 is a graphical representation of the soil sampling data. Based on results from your site and 109 other sites currently under operation, bioventing is cost-effectively remediating fuel contamination in a reasonable time frame. We recommend its continued application at other sites on your installation using the criteria in the AFCEE Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, May 92, and Addendum One to Test Plan and Technical Protocol for a Field Treatability Test for Bioventing-Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential, Feb 94.

The one-year sampling effort was not intended to collect the large number of samples required for statistical significance. It was conducted to give a qualitative indication of changes in contaminant mass. Soil gas samples are somewhat similar to composite samples in that they are collected over a wider area. Thus, they provide a good indication of changes in soil gas profiles and volatile contaminant mass (see Addendum One). Soil samples, on the other hand, are discrete point samples subject to large variabilities over small distances/soil types. This variability, coupled with known sampling and analytical variabilities, would require the collection of a large number of samples to conclusively determine "real" changes in soil contamination. Due to the limited number of final samples collected under this effort, these results should not be viewed as conclusive indicators of bioventing progress or evidence of the success or failure of this technology. In situ respiration tests are considered to be better indicators of hydrocarbon remediation than limited soil sampling.

AQM01-03-0523

Data from your base and many others indicate that BTEX compounds are preferentially biodegraded over TPH. Since BTEX compounds represent the most toxic and mobile fuel constituents, a BTEX standard is a risk-based standard. We strongly encourage its use over an arbitrary TPH standard. Attachment 3 summarizes the BTEX/TPH issue and a report to be sent under separate cover will assist you in negotiating for a BTEX cleanup standard. Our information indicates that South Carolina does not have specific cleanup standards for either BTEX or TPH but bases the ultimate cleanup goal on site specific conditions. We feel such a policy is conducive to negotiating a risk-based approach scenario which will expedite site closure while reducing overall costs.

In general, quantitative destruction of BTEX will occur over a 1 to 2 year bioventing period. Soil gas surveys and respiration tests can be used as BTEX/TPH destruction indicators. In the event that a non-risk-based/TPH cleanup is chosen, a full-scale system should be operated until respiration rates approach background rates. We recommend that confirmatory soil sampling be conducted 4-6 months after background respiration rates are approached.

Sampling results indicate that significant reductions in the BTEX compounds have taken place in the soils within the estimated 30-foot treatment radius of the pilot vent well. In fact all three soil samples collected indicate that the BTEX concentrations are below detection levels. Also note the detection levels shown in Table 2 are well below those required by the South Carolina Department of Health and Environmental Control (i.e., 1 mg/kg BTEX and 10 mg/kg TPH). However, since it appears that the contaminated zone at FT-03 is considerably larger than this 30-foot radius, the results shown in the attached tables can not be considered as representative of the entire site. The oxygen up-take rates shown in Figure 1 indicate that the site is still supporting adequate respiration and degradation rates. Based upon the data in Table 2, AFCEE recommends that the pilot scale bioventing system continue to operate while planning a full-scale expansion of the system with the addition of two additional vent wells. The system expansion can be accomplished through the AFCEE.

Because this is a streamlined test and evaluation project, our contract does not provide for additional reports to the base on pilot study results. The interim results report dated Jan 93 contains as-builts and initial data. This letter summarizes all data collected and provides next step recommendations. AFCEE is no longer responsible for the operation, maintenance, or monitoring of this bioventing system. However, we are in the process of awarding a contract vehicle for extended monitoring, design and expansion of bioventing systems that will be available for your use. Please contact Mr. Marty M. Faile, AFCEE/ERT, DSN 240-4342, COM (210)536-4342, to discuss the technical and contractual options for a full scale expansion.

The blower and accessories are now base property and should continue to be used on this or other bioventing sites. Although current equipment is explosion proof, under no circumstances should it be used for soil vapor extraction unless appropriate explosion-proof wiring is provided. If the base does not want to keep the blower or if you have further questions, please contact us.

On behalf of the AFCEE/ERT staff, I would like to thank you for your support of this bioventing test and evaluation project. The information gained from each site will be invaluable in evaluating this technology and will promote its successful application on other DOD and private sites. I have enclosed a customer satisfaction survey. Please take a few minutes to fill it out and tell us how we did. We look forward to hearing from you.

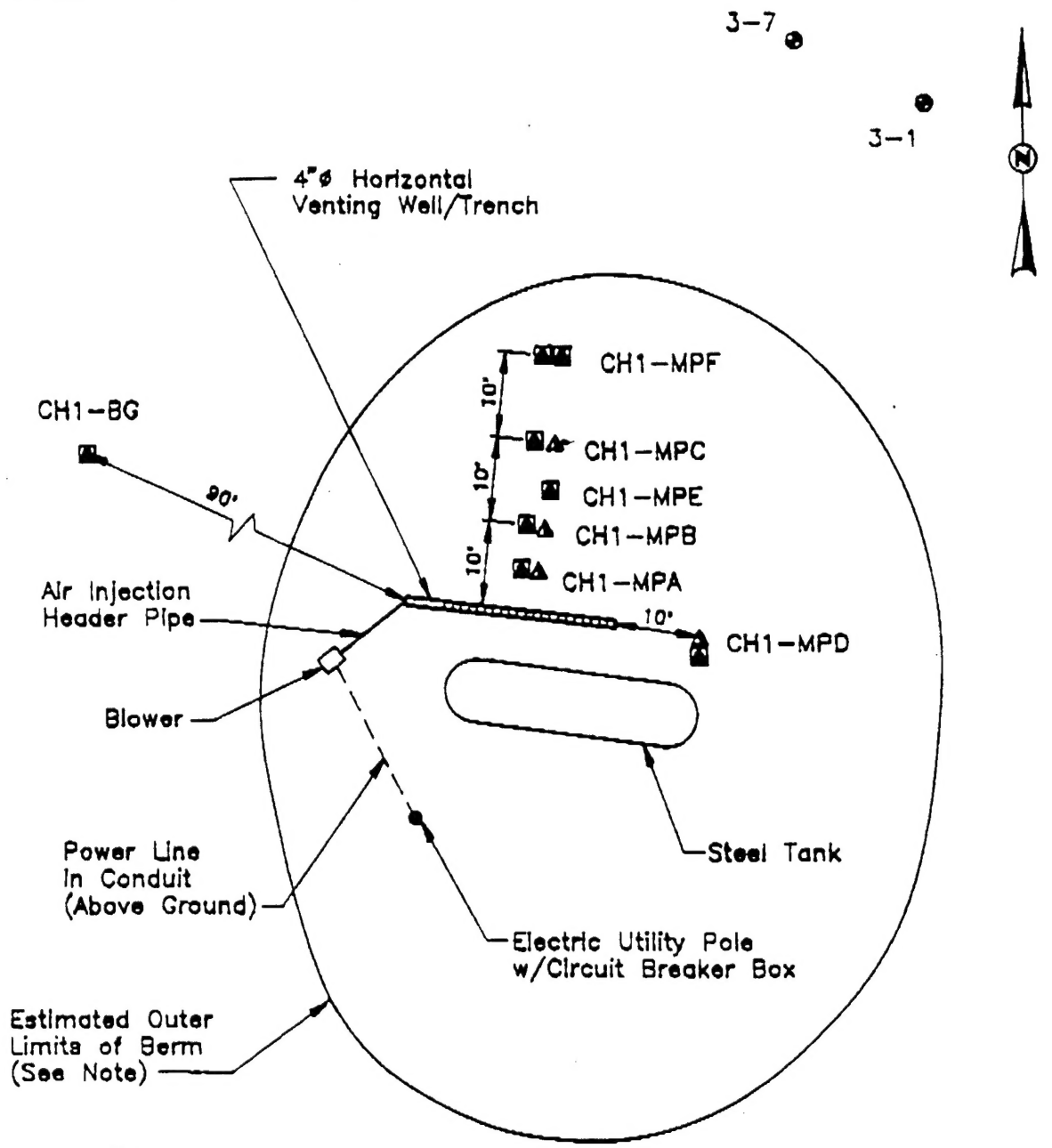
for Mark M. Hall

ROSS N. MILLER, Lt Col, USAF, BSC
Chief, Technology Transfer Division

Attachments:
1. Site Map
2. Analytical Results
3. BTEX Paper
4. Addendum One
5. Survey

cc:
HQ AMC/CEVR
HQ AFCEE/ERD

Figure 1



LEGEND

CH1-MPA ▲	Permanent soil vapor/pressure monitoring point.
CH1-MPA ■	Temporary soil vapor/pressure monitoring point (soil vapor probe).
CH1-BG ■	Temporary background monitoring point.
3-7 ●	Groundwater monitoring well.

NOTE: Soil berm has approximate elliptical dimensions.

20' 10' 0 20'

Approximate Scale in Feet

Venting Well, Vapor Monitoring Points, and Blower Locations

Site FT-03
Fire Training Area
Charleston AFB, South Carolina

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ES ENGINEERING-SCIENCE

TABLE 1
SITE FT-03
RESPIRATION AND DEGRADATION RATES
CHARLESTON AFB, SOUTH CAROLINA

Location-Depth	Initial = November 1992			6-Month = May 1993			1-Year = November 1993		
	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[b/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate[d/] (mg/kg/year)	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)
MPA-3.5	NA[a/]	NA	NA	0.0046	270	19.7	0.00085	120	16.9
MPB-3.5	NA	NA	NA	0.0018	110	NS	0.00045	60	NS
MPC-3.25	NA	NA	NA	NS[c/]	NS	NS	0.00036	70	NS
MPD-1.8	NA	NA	NA	0.0031	370	NS	0.0028	510	NS
MPD-3.9	0.0088	580	19.0	0.014	1690	19.3	0.0025	450	17.3

[a/] Not Available – Point was submerged.
[b/] Milligrams hydrocarbons per kilogram soil per year.
[c/] Not Sampled.
[d/] Assumes moisture content of the soil is average of initial and final moistures.

TABLE 2
SITE FT-03
INITIAL AND 1-YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS
CHARLESTON AFB, SOUTH CAROLINA

Analyte (Units)[a]	Sample Location-Depth (feet below ground surface)					
	MPA-3.5		MPC-3.25		MPD-3.9	
Soil Gas Hydrocarbons	Initial[b]	1-Year[c]	Initial	1-Year	Initial	1-Year
TVH (ppmv)	27	0.47	NS[d]	0.78	790	13
Benzene (ppmv)	<0.002	<0.002	NS	<0.002	<0.04	<0.002
Toluene (ppmv)	<0.002	<0.002	NS	<0.002	<0.04	<0.002
Ethylbenzene (ppmv)	<0.002	<0.002	NS	0.002	0.12	<0.002
Xylenes (ppmv)	0.002	<0.002	NS	<0.002	0.22	<0.002
	VW-3.5		MPA-2.5		MPD-3	
Soil Hydrocarbons	Initial[e]	1-Year[f]	Initial	1-Year	Initial	1-Year
TRPH (mg/kg)	1,100	170	51	12	2,200	2,200
Benzene (mg/kg)	<0.73	<0.0027	<0.72	<0.0006	<1.4	<0.54
Toluene (mg/kg)	2.6	<0.0027	2.7	<0.0006	<1.1	<0.54
Ethylbenzene (mg/kg)	1.6	<0.0027	<0.6	<0.0006	<1.6	<0.54
Xylenes (mg/kg)	4.6	<0.0038	1.3	<0.0006	<2.1	<0.75
Moisture (%)	17.9	8.5	16.8	9.1	12.6	6.6

[a] TRPH=total recoverable petroleum hydrocarbons; mg/kg=milligrams per kilogram; TVH= total volatile hydrocarbons; ppmv=parts per million, volume per volume;
[b] Initial soil gas samples collected on May 6, 1993
[c] Final soil gas samples collected on November 11, 1993
[d] NS=not sampled.
[e] Initial soil samples collected on October 29, 1992
[f] Final soil samples collected on November 11, 1993

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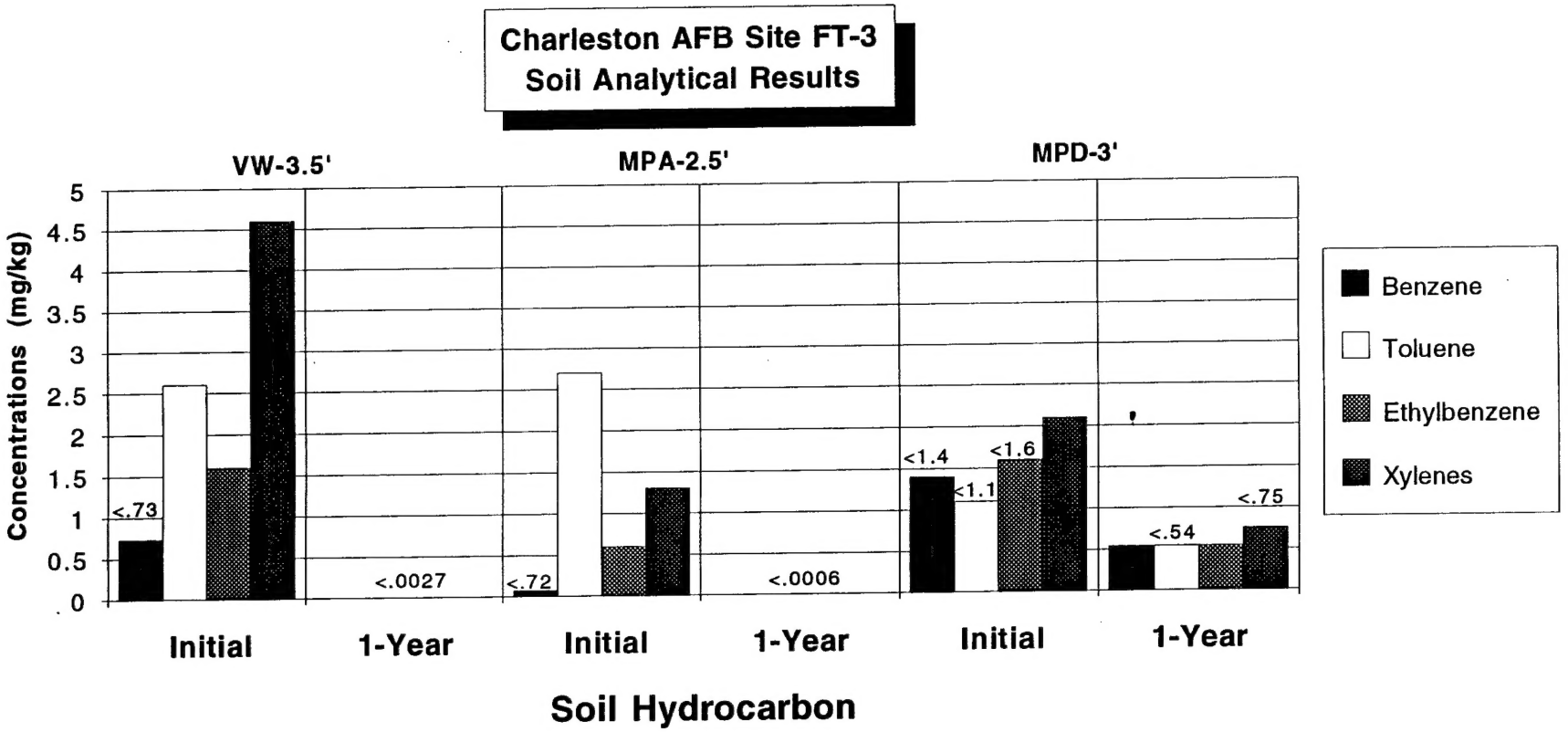
FIGURE 2


Charleston AFB Site FT-3
Soil Analytical Results
VW-3.5'
MPA-2.5'
MPD-3'
Concentrations (mg/kg)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
<.73
<.0027
<.72
<.0006
<1.4
<1.1
<1.6
<.54
<.75
Initial
1-Year
Initial
1-Year
Initial
1-Year
Soil Hydrocarbon
Benzene
Toluene
Ethylbenzene
Xylenes

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